THE WEATHER AND CIRCULATION OF FEBRUARY 1968

Cold and Dry in the East, Warm in the West

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1. MEAN CIRCULATION

The Northern Hemisphere 700-mb. circulation was characterized by large amplitude (fig. 1). In the middle latitudes the anomalous component was largely meridional (fig. 2), especially over North America. However, in the subtropical region the flow was predominantly zonal and much stronger than normal. The core of the strongest westerly winds was displaced well south of normal across both the Pacific and the Atlantic Oceans (fig. 3). These subtropical winds reached record speeds in February. During the 5-day period from the 13th through the 17th of February, the westerly component of the subtropical winds (between 20°N. and 35°N.) averaged 16.7 m.p.s. over the western portion of the Northern Hemisphere, which was a record for this component in any 5-day period since May 1943. The average westerly wind speed for the entire month in this area was 12.0 m.p.s., the second strongest February speed of the subtropical westerlies. The strongest February speed was 13.1 m.p.s. in 1958.

Over North America, the western ridge was in its usual position but was much stronger than normal, while the trough along the East Coast was near its expected location while being anomalously deep. A split westerly pattern (fig. 1 and 3) over the eastern Atlantic resulted in a trough to the west of Spain where a ridge is normally located at this time of year.

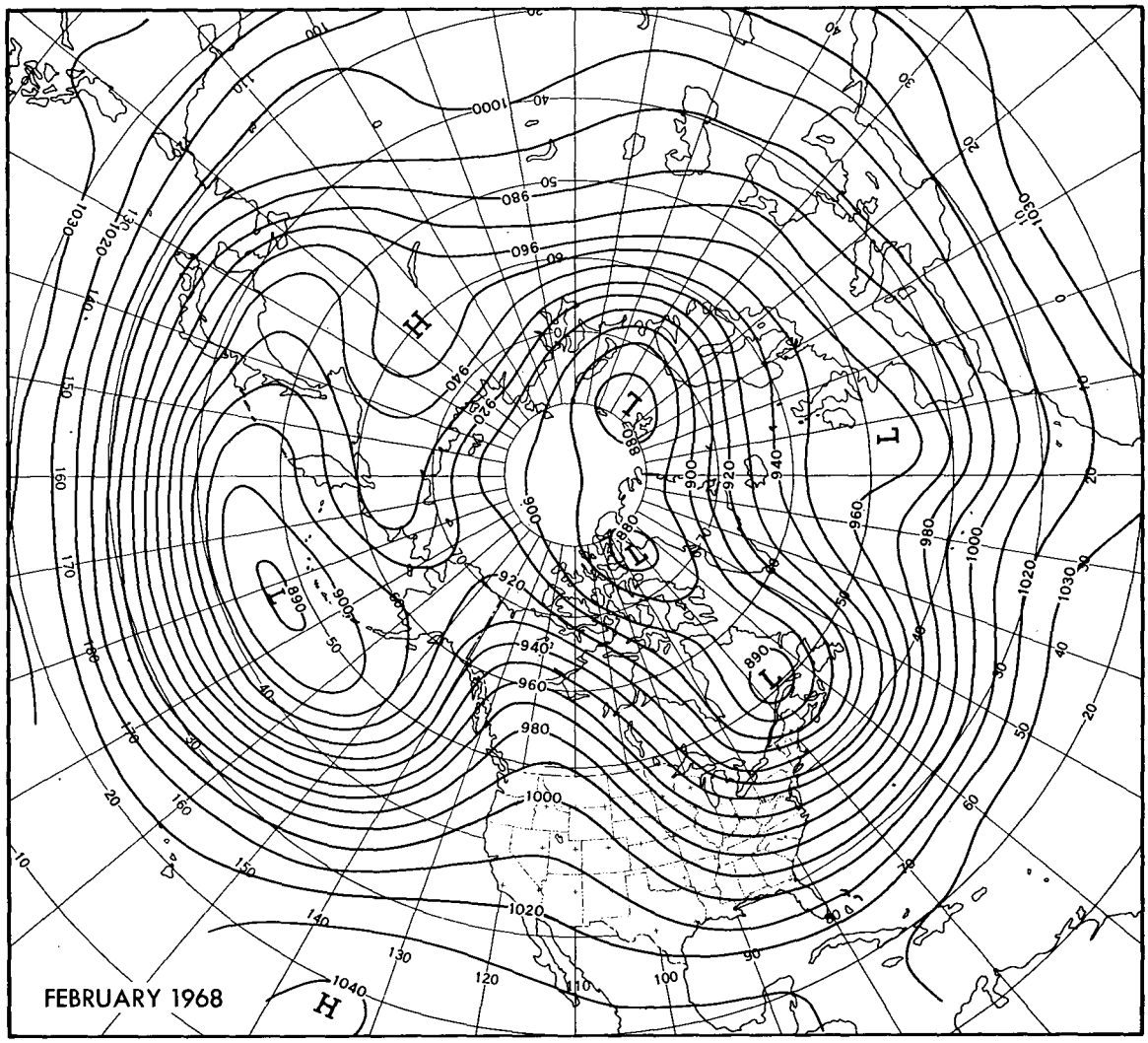


FIGURE 1.—Mean 700-mb. contours (tens of feet) for February 1968.

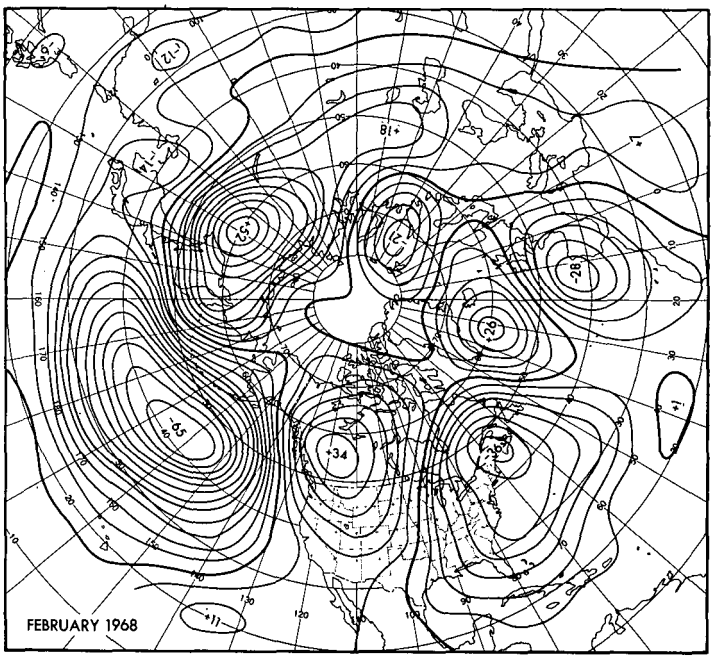


FIGURE 2.—Departure of mean 700-mb. height from normal (tens of feet) for February 1968.

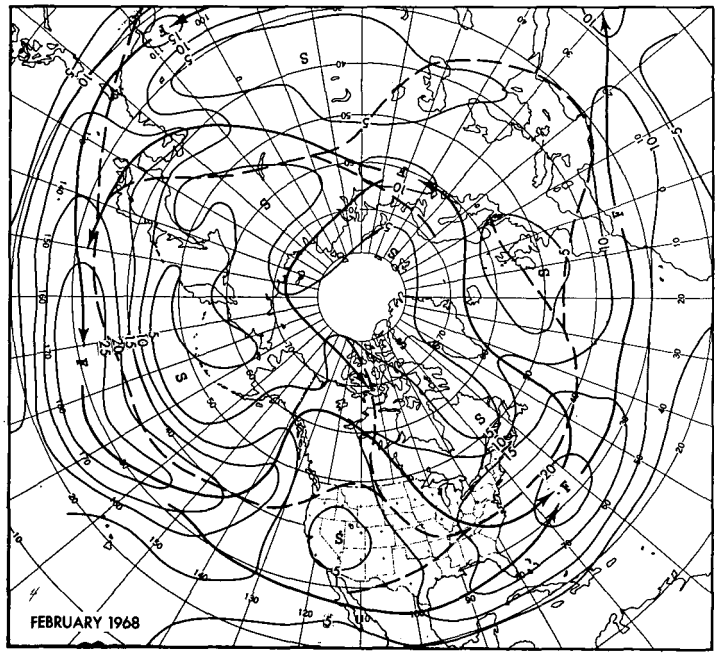


FIGURE 3.—Mean 700-mb. isotachs (meters per second) for February 1968. Solid arrows indicate axes of maximum wind speed and dashed lines the normal.

The Arctic Basin Low was close to its normal February position between Greenland and Novaya Zemlya, but it was deeper than expected. The associated negative height anomaly center was 200 ft. below normal (fig. 2). Across much of Eurasia and parts of North Africa 700-mb. heights were above normal with a 520-ft. positive anomaly center being located northeast of Lake Baikal. To the south of this positive anomaly, 700-mb. heights were below normal over the larger part of China. The Pacific Ocean was dominated by a very large and

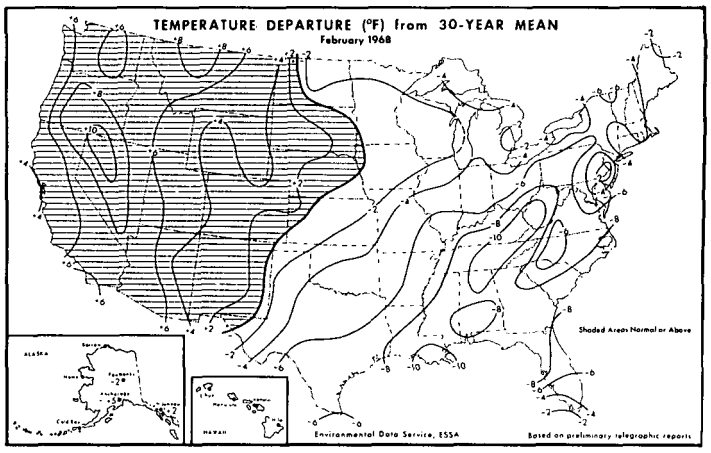


FIGURE 4.—Departure from normal (°F.) of average surface temperature for February 1968 (from [4]).

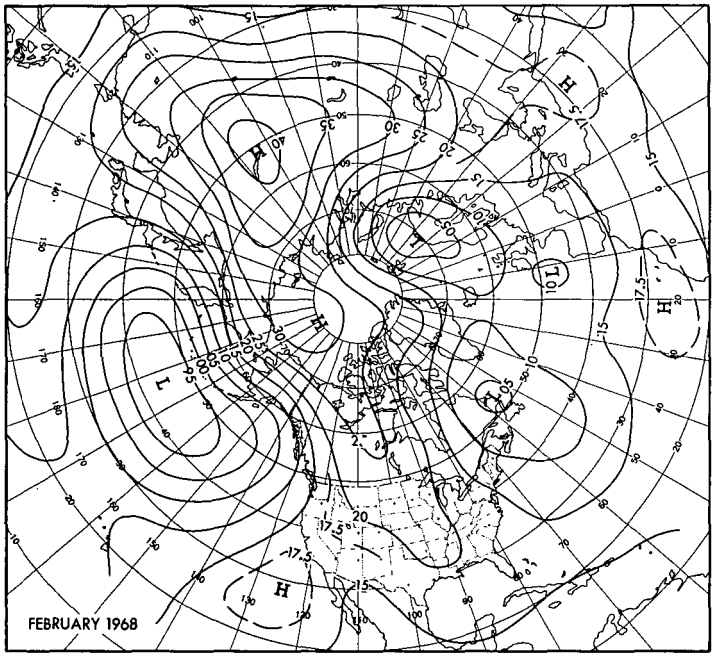


FIGURE 5.—Mean sea level isobars (units and tens of mb.) for February 1968.

extremely deep cyclonic vortex that was 20° east of its normal position over the Kamchatka Peninsula The resulting height anomaly center was 650 ft. below normal.

2. MONTHLY TEMPERATURE

The temperature gradient over the United States for the month of February was in general east-west (fig. 4). Temperatures were well below normal in most of the East and along the Gulf Coast, with a strip of near normal temperatures from Southwest Texas northward through the Plains States to the Canadian border, and much above norma temperatures were observed west of the Rocky Mountains. This temperature pattern was in good agreement with the large amplitude upper level ridge over the West and the deep trough in the East. Also the lower level air flow shown by the mean sea level pressure pattern (fig. 5) would indicate very cold weather

TABLE 1.—*Record or near record mean February temperatures observed in 1968*

Station	Mean temperature °F.	Departure from normal °F.	Remarks
Birmingham, Ala.	38.7	−10.0	3d coldest since 1905
Phoenix, Ariz.	59.7	+6.2	Only Feb. 1 had below normal.
Yuma, Ariz.	64.3	+7.0	Above normal every day
Bakersfield, Calif.	58.9	+6.9	Record
Fresno, Calif.	55.8	+5.3	47.1°F. average minimum was highest of record.
Los Angeles, Calif.	63.8	+6.7	2d warmest. 55.2°F. average minimum was highest of record.
Sacramento, Calif.	55.9	+5.4	2d warmest. 48.4°F. minimum was highest of record.
San Francisco, Calif.	56.7	+3.7	Exceeded only twice since 1872.
Santa Maria, Calif.	56.8	+5.0	47.2°F. average minimum equaled record in Feb. 1907.
Stockton, Calif.	53.9	+4.9	46.9°F. average minimum was highest of record.
Tampa, Fla.	54.3	−8.4	2d coldest
West Palm Beach, Fla.	60.1	−7.5	2d coldest
Hilo, Hawaii (WBAS)	74.9	+4.3	Daily record maximum was equaled or exceeded on 16 days.
New Orleans, La.	47.2	−10.5	Coldest since 1895
Jackson, Miss.	39.9	−10.6	2d coldest
Elko, Nev.	39.8	+11.8	Record
Ely, Nev.	35.8	+9.2	2d warmest
Wilmington, N.C.	40.3	−8.4	Record
Youngstown, Ohio	19.5	−8.1	2d coldest
Salem, Oreg.	48.1	+6.2	2d warmest
Medford, Oreg.	39.5	+9.8	Warmest since 1934
Charleston, S.C. (WBAS)	41.8	−9.7	Record
Columbia, S.C.	40.1	−8.3	Coldest since 1905
Port Arthur, Tex.	48.0	−8.0	2d coldest
Elkins, W. Va.	22.0	−11.0	Coldest since 1947

in the East and relatively warm conditions in the southerly flow over the West with intermediate temperatures in between.

Table 1 lists the stations with the most extreme temperatures. A few stations in the West such as Bakersfield, Calif., and Elko, Nev., reported the highest mean February temperature of record, but several others had near record warmth. Persistent cloudiness in California and nearby states caused several stations including Stockton and Los Angeles to observe record or near record high average minimum temperatures. For instance, Santa Maria, Calif., reported 23 cloudy days instead of the usual 10 and also reported a minimum of 47.2°F. which equaled the previous high minimum temperature record established during the first year of observation in 1907. Snowfall from the early December blizzard at Winslow, Ariz. [1], finally melted by the 11th of February and the local daily mean temperature was above normal every day from the 8th through the 28th. The usual effect of anomalous snow cover [2] that did remain in adjacent areas of the southern and central Rocky Mountains was minimal this month owing to the strong influx of warm air accompanying the large amplitude ridge over the Plateau States and the Rocky Mountains.

In the East, there were several stations that experienced the coldest February of record and many other areas reported near record temperatures (table 1). There were frequent remarks of a cold and dry month in the local climatological reports from stations in the East. The report from Boston, Mass., was extremely emphatic—"February was very cold, very dry, very sunny, with very clear air." The near record coldness extended westward to Ohio in the north and to eastern Texas in the south. Few daily records were set; the record averages were established by the persistence of the cold after a few early days of relative warmth.

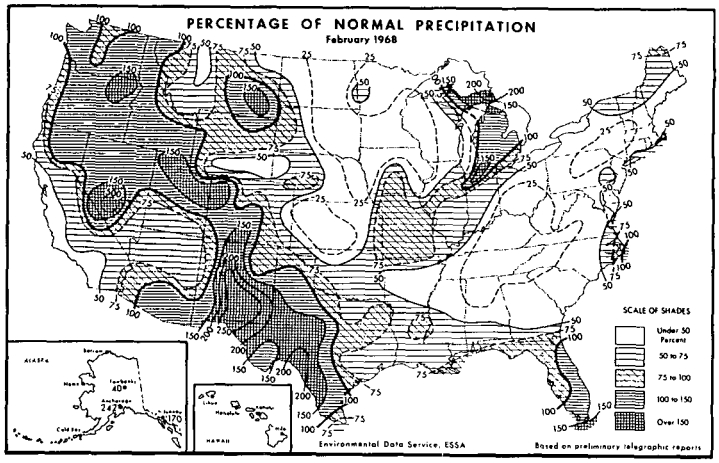


FIGURE 6.—Percentage of normal precipitation for February 1968 (from [4]).

Temperatures in Alaska were above normal along the southern coast and below normal inland, along the northern and western coasts, and in the Cold Bay area on the Alaska Peninsula. Kotzebue was the coldest relative to normal of the major reporting stations in Alaska with an average temperature of −17.5°F., which was 13.5°F. below normal. A minimum temperature of −52°F. on the 22d and 24th equaled the all time record low for Kotzebue.

In Hawaii a persistent anomalous westerly 700-mb. wind (fig. 2) gave the Hilo Airport an unusually high average temperature (table 1) with maximum daily temperatures that either equaled or exceeded the record on 16 days. The effect of these westerly winds in other areas of Hawaii was not the same because of the difference in terrain. Lihue and Kahului, for instance, had slightly below normal temperatures, and the substation at Honolulu reported only 1.1°F. above normal.

3. MONTHLY PRECIPITATION

The large amplitude flow over North America also produced a contrasting precipitation regime across the Nation during February (fig. 6). The majority of the Country from the Plains eastward was extremely dry in response to the anomalously cold and dry northerly winds (fig. 2). The major exceptions were just to the lee of Lake Superior and Lake Michigan, where more than normal precipitation was recorded. Marquette, Michigan, on the south shore of Lake Superior, reported the largest February precipitation in 20 yr., and Sault Ste. Marie, Mich., observed the largest precipitation amount of record for the month. This is an excellent example of the "lake effect," where unusually cold and dry air picks up moisture passing across the Great Lakes and deposits this moisture in the form of snow on the leeward side. Sault Ste. Marie also reported a record snowfall. However, the lake effect did not appear to the lee of Lake Ontario or Lake Erie, for those lakes had more than normal ice during February. Lake Superior, however, had less than normal ice and Lake Michigan had about normal [3]. Colder than normal water temperatures in Lake Ontario

TABLE 2.—*Record or near record February precipitation amounts observed in 1968*

Station	Total precipitation (in.)	Departure from normal (in.)	Remarks
Birmingham, Ala.	1.20	−4.08	Record
Washington, D.C.	.80	−1.67	2d driest (exceeded only by 1901, a 28-day month, 0.33 in. fell on 29th).
Waterloo, Iowa	.04	−.88	Equaled record.
Cairo, Ill.	2.33	−1.34	Only 0.06 in. fell after 1st for longest dry Feb. period.
Augusta, Ga.	.65	−2.83	Record
Louisville, Ky.	.80	−2.49	Driest since 1947
Portland, Maine	1.26	−2.54	Driest since 1895
Marquette, Mich.	3.08	+1.43	Largest Feb. amount in 20 yr.
Sault Ste. Marie, Mich.	3.25	+1.75	Record; 39.5-in. snowfall was largest for Feb.
Albany, N.Y.	.36	−1.84	Driest since 1877
Trenton, N.J.	1.15	−1.44	2d driest
Boston, Mass. (WBAS)	1.15	−2.17	Driest since 1901
Duluth, Minn.	.22	−1.74	Driest since 1896
Akron, Ohio	.48	−1.91	Record
Columbus, Ohio	.38	−1.93	Driest since 1878
Allentown, Pa.	1.31	−1.33	Driest since 1912
Harrisburg-York, Pa. (WBAS)	.53	−1.87	Equaled record dryness in 1901 (a 28-day month; 0.34 in. fell on 29th).
Wilkes Barre-Scranton, Pa. (WBAS).	.30	−1.69	Record
Huron, S. Dak.	.03	−.57	Tied 1921 for driest Feb.
Memphis, Tenn.	1.98	−2.71	Driest in 19 yr.
Salt Lake City, Utah	2.32	+1.14	2d wettest at airport
Parkersburg, W. Va.	.58	−2.25	Driest since 1885
Green Bay, Wis.	.45	−.63	5th time in 80 yr. with 3 in. or less snowfall.

[3] may have had a greater effect than the ice cover, since most of this Lake was still open even though it had more than normal ice [2].

Many stations in eastern United States reported the driest February of record, and many more stations reported near record dryness (table 2). Extreme dryness was also observed in the Northern Plains and the northern Mississippi Valley. Duluth, Minn., recorded the least February precipitation of record, and Huron, S. Dak., tied the record dryness established in 1921. This area was also to the east of the strong upper level ridge.

The relatively heavy precipitation that fell in West Texas, New Mexico, and adjacent areas was related to the upslope lower level winds (fig. 5), for this region was also to the east of the mean upper level ridge. The monthly mean low level flow was southerly over most of the states west of the Rocky Mountains; and as a result, most of these sections had more than normal precipitation. This seasonally excessive precipitation was welcomed. Much of this area had been unusually dry and even with this above normal monthly precipitation the area still is greatly in need of rain. Pendleton, Oreg., had above normal precipitation for the first month since January 1967 and reported the lowest seasonal total since September of record. Walla Walla, Wash., reported 2.42 in. which was .90 in. above normal, but the total since September 1 was 9.29 in. below normal. Wendover, Utah, had more than twice normal precipitation after 4 mo. with below normal rain and snow.

The greatest exception to the above normal precipitation regime in the West was coastal and some inland parts of California where generally light westerly to northwesterly winds associated with an offshore mean surface anticyclone (fig. 5) gave relatively dry conditions. There was a sizable area in northern Arizona and southern Utah and

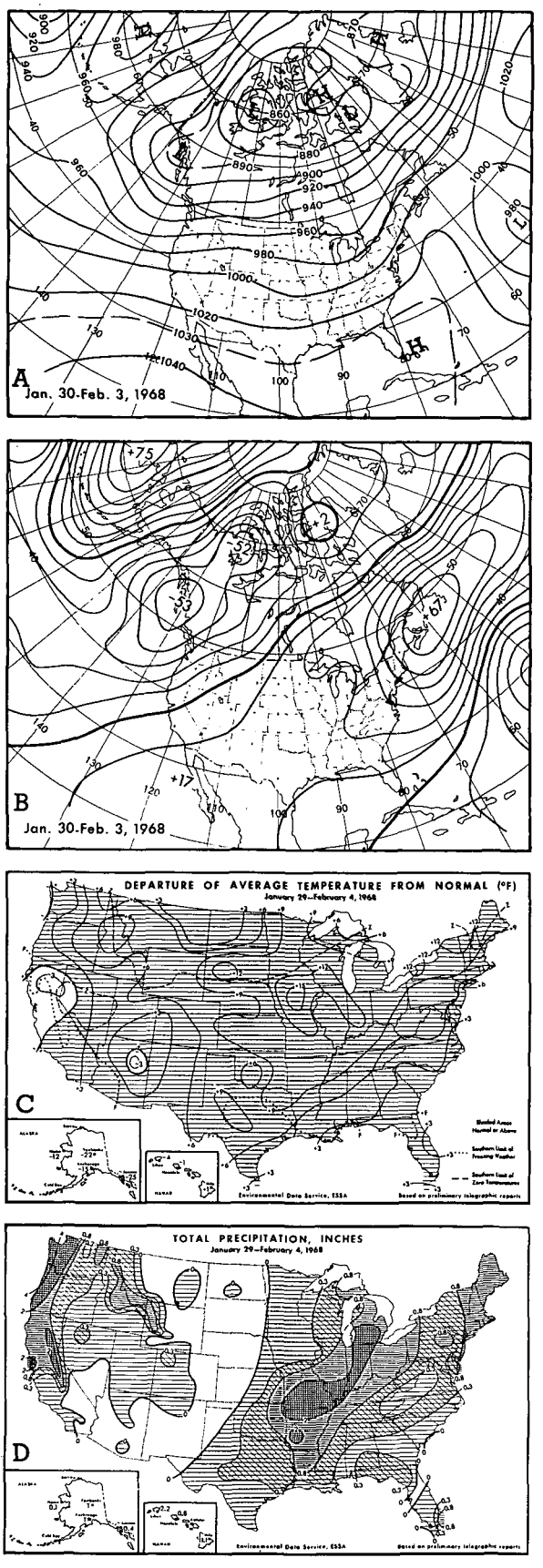


FIGURE 7.—(A) Mean 700-mb. contours and (B) departure from normal (both in tens of feet) for Jan. 30–Feb. 3, 1968; (C) departure of average surface temperatures from normal (°F.); and (D) total precipitation (inches) for week of Jan. 29–Feb. 4, 1968 (from [4]).

Nevada that had less than 75 percent of normal precipitation also.

4. VARIATIONS WITHIN THE MONTH

Small amplitude zonal flow over North America (fig. 7A) and above normal 700-mb. heights over all of the United States except the Far Northwest (fig. 7B) was causing abnormally warm weather across most of the Nation as February began (fig. 7C). The exceptions were the Winslow, Ariz., area, a large section of northern California, and western Nevada where temperatures were slightly below normal. During the first 2 or 3 days of the month the warmth was quite extreme. In Burlington, Vt., 46°F. established a new record maximum temperature on the 2d, and 52°F. set a maximum record at Lansing, Mich., on the 1st of the month.

A Colorado-type Low moved from a position in western Kansas during the first day of February to the Great Lakes and into Ontario on the 2d, causing most of the precipitation in the East (fig. 7D). In the Far West the heavier precipitation was the result of the anomalously strong southwesterly upper level flow, which extended to the Northern Rockies. The flat mean ridge and foehn effects of the mountains gave extreme dryness to the western and northern parts of the Great Plains early in February.

Strong amplification occurred during the week of February 5–11 (fig. 8A) with a cutoff Low forming off the California coast. A very strong ridge developed over the Rocky Mountains and an intense trough developed along the Atlantic coast with a Low centered over the mouth of the St. Lawrence River. 700-mb. heights were 740 ft. above normal over the Canadian Rockies, and 420 ft. below normal off the Carolina-Georgia coast (fig. 8B).

Temperatures in the East dropped sharply (fig. 8C) with three successive thrusts of cold air, the first surge of cold air having arrived late in the previous week. The coldest area, relative to normal, was the coastal section of Mississippi and Alabama where temperatures were 12°F. below normal. In the western half of the Nation temperatures were well above the normal in most areas. Exceptions were around Winslow, Ariz., and some of western Wyoming where temperatures were slightly below normal. The below normal temperature at Winslow could be accounted for by the presence of anomalous snow cover, and the lower temperatures in Wyoming resulted from the presence of a mean surface high pressure centered over the area (not shown) that caused strong nocturnal cooling in the lower layers.

Precipitation was relatively light over most of the Nation this week as a result of the amplified ridge and the fact that the major storms associated with the eastern trough occurred over the Atlantic. The precipitation in Nevada and Southern Arizona, which was above normal for those areas this week, was caused by the southerly flow east of the Low near California (fig. 8A).

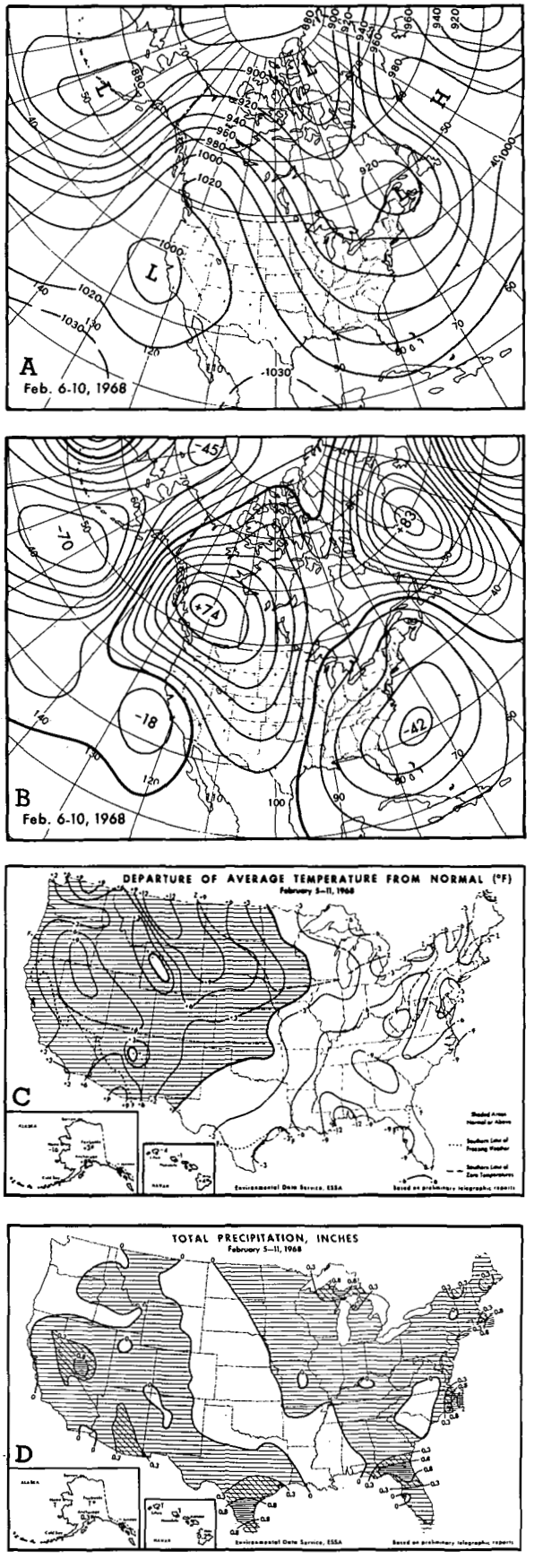
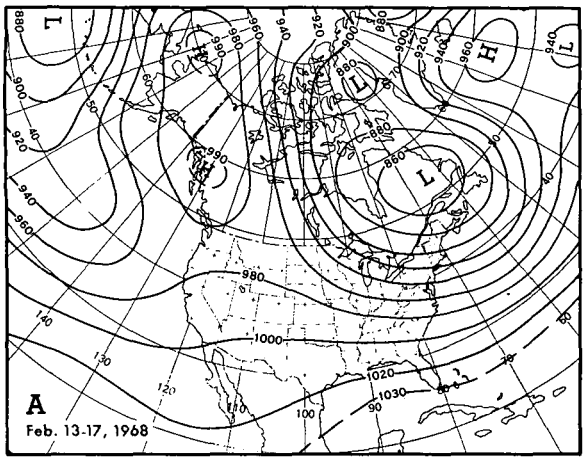
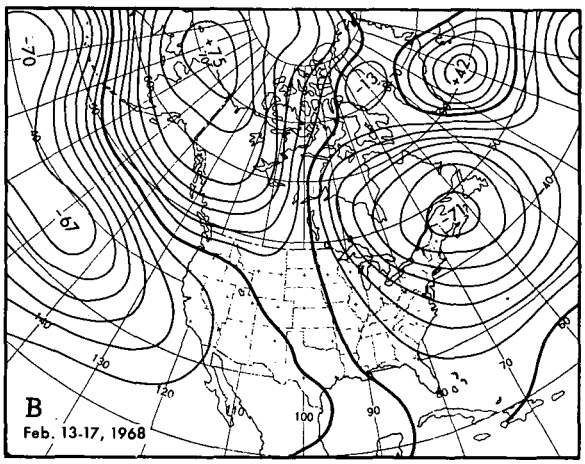
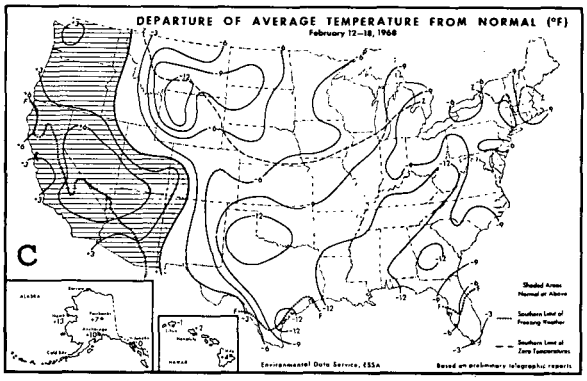


FIGURE 8.—Same as figure 7, (A) and (B) for Feb. 6–10, 1968; (C) and (D) for week of Feb. 5–11, 1968 (from [4]).







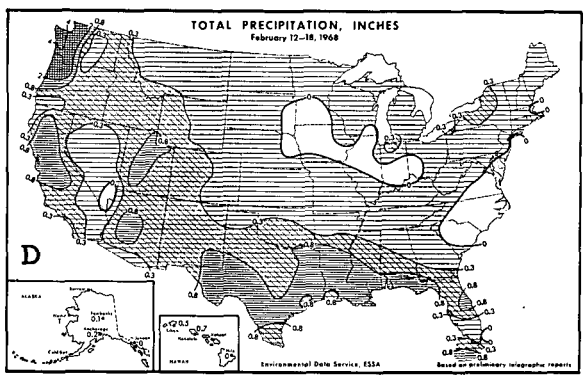
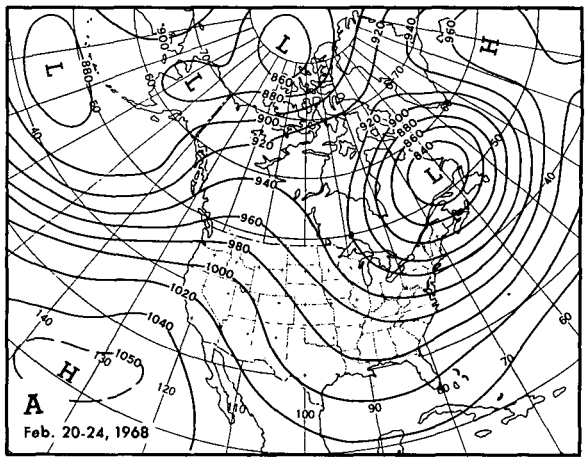
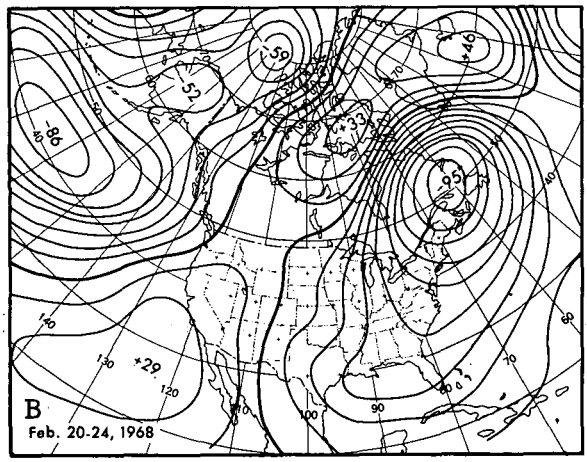
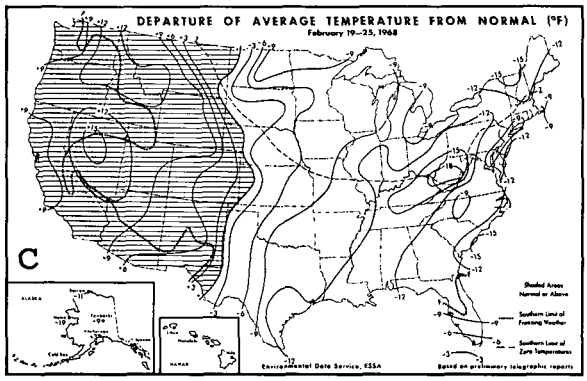


FIGURE 9.—Same as figure 7, (A) and (B) for Feb. 13–17, 1968; (C) and (D) for week of Feb. 12–18, 1968 (from [4]).







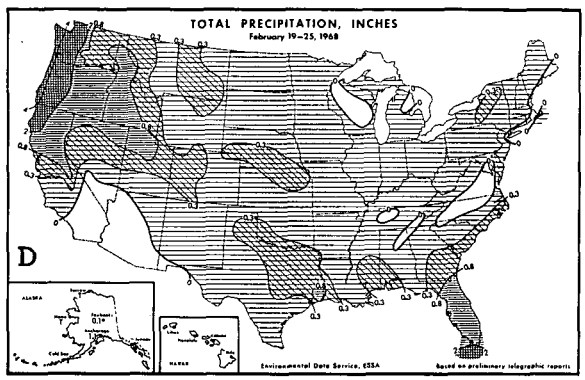
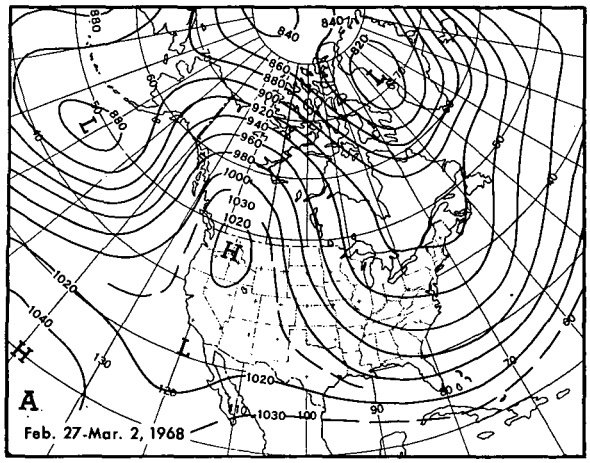
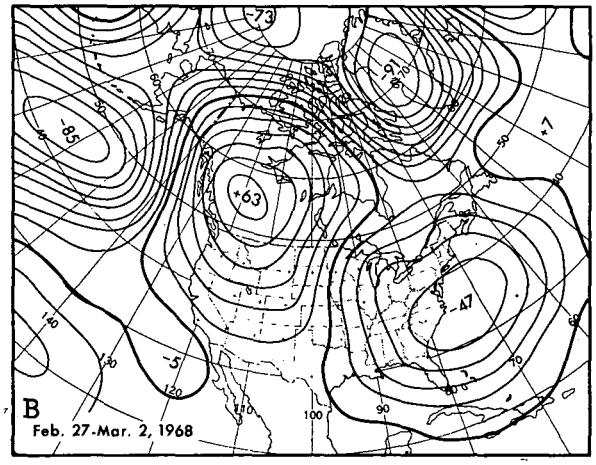
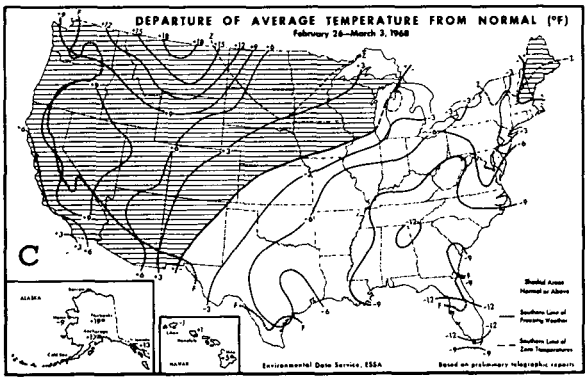


FIGURE 10.—Same as figure 7, (A) and (B) for Feb. 20–24, 1968; (C) and (D) for week of Feb. 19–25, 1968 (from [4]).







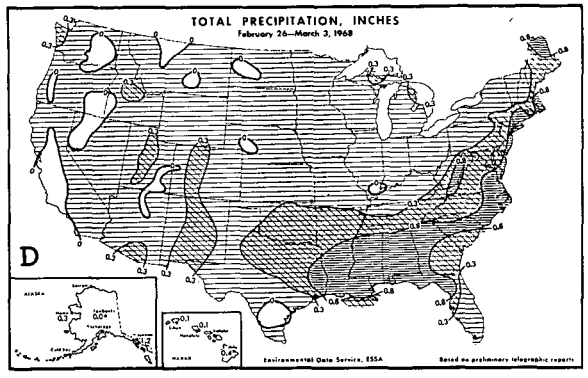


FIGURE 11.—Same as figure 7, (A) and (B) for Feb. 27–Mar. 2, 1968; (C) and (D) for week of Feb. 26–Mar. 3, 1968 (from [4]).

In the succeeding week the centers of the upper level anticyclones associated with the western ridge retrograded northwestward (fig. 9A), and 700-mb. height anomalies lowered over the West (fig. 9B). The strong anomalous northerly flow shifted westward over North America and brought very cold air to all areas of the United States except the Far West (fig. 9C). East of the Rockies and north of the Gulf States precipitation was again quite light (fig. 9D), as the anomalous northerly flow kept storm activity out of this portion of the Country. Waves on the polar front in the Gulf of Mexico caused the larger amounts of precipitation in the Gulf Coast States, while heavy precipitation in the Northwest was the result of a Pacific storm late in the week. The other appreciable precipitation in the West was caused by southwesterly upper level flow and a minor surface low pressure system that moved southeastward through the Great Basin and into the Gulf of Mexico during the week.

Reamplification of the ridge over western United States occurred again in the February 19–25 week (fig. 10A), returning the warm air which was associated with the above normal 700-mb. heights (fig. 10B and 10C). Fairly strong onshore upper level flow caused the heavy precipitation in the Northwest to continue. The very strong anomalous northerly flow in the East persisted the extremely dry and cold regime from the Plains States eastward (fig. 10C and 10D).

During the last days of February and the first days of March amplification continued over North America (fig. 11A) with a 630-ft. positive anomaly center located in almost the exact position of the 730-ft. anomaly early in the month (fig. 8B and 11B). Temperature patterns were also very similar (fig. 8C and 11C). A developing storm moved from the Gulf Coast through the Southeast on the last day of the month, producing the significant amounts of precipitation shown in figure 11D. It was very dry over most of the remainder of the Country late in the month.

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